



Missouri's Aquatic Ecosystems

Ecosystems are complex interdependent webs of relationships between living and non-living things. Missouri has three kinds of aquatic ecosystems: streams, lakes and wetlands.

Estimated Time

Four 50-minute
class sessions

Technology Tools/Skills Used in Chapter

Line transect sampling
technique for collecting
plant data.

Safety Precautions/Concerns

Identify and stay clear of poison
ivy and other dangerous plants.

Vocabulary

Aquatic ecosystem
Biodiversity
Buffer
Current
Ecosystem
Lake
Marsh
Oxbow lake
Pond
River
Slough
Stream
Swamp
Wetland

Chapter Objectives

Students will be able to:

1. Define ecosystem and identify the factors that make up an ecosystem.
2. Explain how the parts of an ecosystem interact with one another.
3. Identify Missouri's aquatic regions and explain how the characteristics of the land affect the nature of the water.
4. Compare and contrast Missouri's aquatic ecosystems types.
5. Define biodiversity and assess its importance.
6. Predict the impact of a natural or human-caused environmental change on the organisms in an ecosystem.
7. Describe possible solutions to potentially harmful environmental changes within an ecosystem.

Targeted Grade-Level Expectations

EC.1.A.6.a. Identify the biotic factors (populations of organisms) and abiotic factors (e.g., quantity of light and water, range of temperatures, soil composition) that make up an ecosystem

EC.1.D.6.a.

EC.1.D.6.b. Predict the impact (beneficial or harmful) of a natural environmental change (e.g., forest fire, flood, volcanic eruption, avalanche) on the organisms in an ecosystem

EC.1.D.6.c. Describe possible solutions to potentially harmful environmental changes within an ecosystem

IS.1.C.6.a.

Reference Material for Teacher Background

- DVD Compilation for *Conserving Missouri's Aquatic Ecosystems*
- Help Stop Aquatic Hitch Hikers (FIS002)
- Introduction to Crayfish (FIS011)
- Introduction to Missouri Fishes (FIS020)
- Know Missouri's Catfish (FIS003)
- Life Within the Water (FIS034)
- Map: Smallmouth Bass (FIS019)
- Map: Trout Fishing In Missouri (FIS210)
- Missouri Aquatic Snails (SCI017)
- Missouri Fresh Water Mussels (E00019)
- Missouri Marsh Birds (E00042)
- Missouri Toads and Frogs (E00430)
- Missouri Turtles (E00468)
- Missouri Wetlands (SCI149)
- Missouri Wetlands & Their Management (SCI150)
- Nuisance Aquatic Plants in Missouri Ponds and Lakes (FIS110)
- Plants for Wetland Habitat (SCI008)
- Poster: Aquatic Invasive Species (FIS029)

- Poster: Exploring Missouri Wetlands (E00003)
- Poster: Missouri Fishes (E00013)
- Poster: Missouri Pond Life (E00002)
- Poster: Missouri Stream Life (E00016)
- Poster: Rivers and Streams: Missouri Currents (E00509)
- Poster: Salamander (E00089)
- Poster: Toads & Frogs (E00012)
- Poster: Wetlands & Waterfowl (E00115)
- Zebra Mussels: Missouri's Most Unwanted (FIS013)
- *Crayfishes of Missouri* (01-0250)
- *Fishes of Missouri* (01-0031)
- *Amphibians and Reptiles of Missouri* (01-0190)
- *Missouri Naiads* (01-0150)
- *Pond Life: Revised and Updated (A Golden Guide from St. Martin's Press)* by George K. Reid
- *WOW! The Wonders of Wetlands*

Required Materials

- DVD Compilation for *Conserving Missouri's Aquatic Ecosystems*
- Missouri Pond Life poster (E00002)
- Exploring Missouri Wetlands poster (E00003)
- Rivers and Streams: Missouri Currents poster (E00509)
- *Fishes of Missouri* (01-0031)
- Introduction to Missouri Fishes (FIS020)
- TV/DVD player
- Notebook paper
- Pens or pencils
- Computer with internet connectivity (optional)
- 1 copy of Plant Sampling—Line Transect Survey Investigation for each student
- Set of transect lines—one for each group in class (Advanced preparation is required.)
- Mallet or hammer for driving wooden transect stakes (optional)
- Set of plant identification field guides—one for each group in class

Activity 6.1: Exploration of Students' Current Understanding of Missouri's Aquatic Ecosystems

This activity explores students' current understanding of Missouri's aquatic ecosystems.

Estimated Time

10 minutes

Required Materials

- Missouri Pond Life poster (E00002)
- Exploring Missouri Wetlands poster (E00003)
- Rivers and Streams: Missouri Currents poster (E00509)

Procedure

1. Display the three Missouri aquatic ecosystem posters in the classroom.
2. Use a cooperative learning activity to explore the following:
 - Which of the following are found in Missouri: rivers, lakes, swamps, oceans?
 - Which of these is nearest to our school?
 - How many have you visited?
 - Invite students to share briefly about their last visit to one of these ecosystems.
3. Explain to the class that this chapter will help them understand what an ecosystem is and what kinds of aquatic ecosystems are found in Missouri.

Activity 6.2: Video Exploration of Invasive Species in Missouri's Aquatic Ecosystems

This activity helps students understand the concept of invasive species and provides examples of how invasive species impact Missouri's aquatic ecosystems.

Estimated Time

15 minutes

Required Materials

- DVD Compilation for *Conserving Missouri's Aquatic Ecosystems*
- TV/DVD player

Procedure

1. Remind students of the "Jumping Carp" video clip and explain that the next two video clips show how other invasive species are affecting Missouri's aquatic ecosystems.
2. Show the video clips: "Purple Loosestrife" and "Zebra Mussels."
3. Use a cooperative learning activity to explore the following questions:
 - How have these three invasive species (bighead/silver carp, purple loosestrife and zebra mussels) entered Missouri's aquatic ecosystems?
 - How are these three invasive species (bighead/silver carp, purple loosestrife and zebra mussels) impacting Missouri's aquatic ecosystems?
 - What can humans do to reduce, eliminate or make up for the impact of these three invasive species on Missouri's aquatic ecosystems?
4. Have students record their thoughts and observations in their science notebooks.

Activity 6.3: Video Exploration of Endangered Species in Missouri's Aquatic Ecosystems

This activity helps students understand the concept of endangered species and provides examples of endangered species in Missouri's aquatic ecosystems.

Estimated Time

25 minutes

Required Materials

- DVD Compilation for *Conserving Missouri's Aquatic Ecosystems*
- TV/DVD player
- Introduction to Missouri Fishes (FIS020)
- *Fishes of Missouri* (01-0031)

Procedure

1. Use a cooperative learning activity to explore the following questions:
 - What does it mean for a species to be extinct?
 - How does a species become extinct?
 - Can you think of any species that are now extinct?
 - Can you think of any species that once lived in Missouri and no longer do?
 - What does it mean for a species to be endangered?
 - Can you think of any species that are now endangered?
 - What can humans do to prevent species from becoming endangered or extinct?
2. Have students record their thoughts and observations in their science notebooks.
3. Show the video clips: "Topeka Shiner" and "Niangua Darter."
4. Have students add Topeka shiner and Niangua darter to the comparison matrix of fish species they started in Activity 4.4 and continued in Activity 5.4 and 5.6. Have students investigate the Topeka shiner and Niangua darter. Class time may be provided or research may be assigned as homework. Have students record their findings by completing rows of the comparison matrix.
5. Use a cooperative learning activity to explore the following questions:
 - Why have these species become endangered?
 - What are humans doing to prevent these species from becoming extinct?
 - How would the loss of these species impact Missouri's aquatic ecosystems?
6. Have students record their thoughts and observations in their science notebooks.

Activity 6.4: Student Reading and Research

This activity provides students with definitions and explanations about Missouri's aquatic ecosystems.

Estimated Time

Varies—class time may be provided or reading may be assigned as homework. Allow at least 20 minutes for in-class questions and discussion.

Required Materials

- Student Guide
- Notebook paper (optional)
- Pens or pencils (optional)

Procedure

1. Have students read Chapter 6: Missouri's Aquatic Ecosystems. Introduce vocabulary terms as needed.
2. Assign the **Questions to Consider** as homework or use them in a cooperative learning activity.
 1. What is an ecosystem? What are some of the parts of an ecosystem?
An ecosystem is a complex web of relationships between living and non-living things. The biotic (living) parts of the ecosystem are the communities of plant and animal populations, including humans. The abiotic (non-living) parts include sunlight, air, water, temperatures, soil and minerals.
 2. How do the parts of an ecosystem interact with one another?
Each part of an ecosystem is connected to and depends on all the others. It takes all the parts interacting to make the system work. All populations living together within a community interact with one another and with their environment in order to survive and maintain a balanced ecosystem. Conversely, a healthy, balanced ecosystem provides for all the needs of the communities that live in it.
 3. What are Missouri's aquatic regions? How do the characteristics of the land affect the nature of the water?
The characteristics of the land in each of Missouri's five physiographic regions affect the nature of Missouri's waters and watersheds. Missouri has four different aquatic regions. The four regions are the Ozarks, Prairie, Lowland and Big River. Just as different watersheds create different water bodies, different aquatic regions support different kinds of life.
 4. What kinds of aquatic ecosystems do we have in Missouri? How are they alike or different from one another?
Missouri has three kinds of aquatic ecosystems: streams, lakes and wetlands. Rivers and streams contain flowing water. Rivers are just large streams. Lakes and ponds contain standing water. Lakes are larger than ponds. Wetlands are covered with shallow water at least part of the year. Missouri has two main kinds of wetlands—marshes and swamps. Marshes have cattails or other grass-like plants. Swamps have trees or woody shrubs.
 5. What is biodiversity? Why is it important?
Biodiversity refers to the variety and number of different organisms and populations in a community, and the way they live together. The greater the biodiversity in an ecosystem, the healthier, more sustainable and better balanced it is. Biodiversity is very important to the stability of an ecosystem. If many different species are present, then the loss of one or two will probably not have a great effect. But if species diversity is low, the loss of one or two could have a major impact.
 6. How do humans impact aquatic ecosystems?
A human activity such as straightening a stream speeds up erosion and cuts out curves that shelter fish and other aquatic life. Changes may destroy habitat for some species and create it for others. Some human activities that can reduce aquatic biodiversity are draining a swamp, damming a river or pumping out water. These activities destroy habitat, which is the main cause of species decline.
 7. How can we help conserve aquatic ecosystems?
Protecting and restoring a wide variety of habitat helps keep species from becoming endangered or extinct.

Activity 6.5: Student Investigation of Conserving Aquatic Ecosystems

This activity helps students understand how humans can help conserve aquatic ecosystems.

Estimated Time

20 minutes

Required Materials

- DVD Compilation for *Conserving Missouri's Aquatic Ecosystems*
- TV/DVD player

Procedure

1. Use a cooperative learning activity to have students review and brainstorm some ways humans can help conserve aquatic ecosystems.
2. Show the video clip: "Stream Teams."
3. Have students write a science notebook entry exploring something they would like to do themselves to help conserve Missouri's aquatic ecosystems.

Activity 6.6: Video Exploration of Sampling

This activity helps students understand the concept of sampling. It provides examples of sampling methods used by scientists in Missouri aquatic ecosystems.

Estimated Time

25 minutes

Required Materials

- DVD Compilation for *Conserving Missouri's Aquatic Ecosystems*
- TV/DVD player
- Notebook paper (optional)
- Pens or pencils (optional)

Procedure

1. Use a cooperative learning activity to have students review ways of checking the health of an aquatic ecosystem (should include physical and chemical water testing, observation of watershed land uses and conditions, observations of populations and community interactions). Explain that they will now look at some ways scientists check the health of aquatic ecosystems by making observations of populations and community interactions.
2. Show the video clip: "Wranglers of the Deep." Ask students to take notes in their notebooks of the different sampling methods depicted (electrofishing, netting and creel sampling). After the video clip, review these with the class.
3. Show the video clip: "Crustacean Calculation." Lead class discussion of why scientists use sampling. Ask students to imagine that they have just been given the task of finding out how many dandelions or how many blades of grass are on the school grounds. Ask students how they would go about finding out. Explain that this problem is similar to the problems scientists face all the time. They might solve the problem by getting down on their hands and knees and counting every dandelion on the school grounds. This might take a very long time but if done carefully it would give a precise answer. It is often unrealistic for a scientist to count every organism in her/his research area. What scientists often do is to work with a sample, a small section or plot of their research area. From their sample the scientist can then estimate many things about their research area without having spent all the time to count each organism. Scientists do not base their calculations on just one sample. Instead they use data from many samples. Ask students why scientists do this. (To get the most accurate analysis of the data collected we will look at multiple samples.) Explain that the precise technique or sampling method used depends what you are sampling.

Activity 6.7: Student Investigation of Sampling

This hands-on activity helps students understand the concept of sampling and introduces students to the line transect sampling technique for collecting plant data in the field.

Estimated Time

One 50-minute class followed by
25 minutes of discussion the next day.

Safety Precautions/Concerns

- Identify and stay clear of poison ivy and other dangerous plants.

Required Materials

- Pens or pencils
- 1 copy of Plant Sampling—Line Transect Survey Investigation for each student
- Set of transect lines—one for each group in class (Advanced preparation is required.)
- Mallet or hammer for driving wooden transect stakes (optional)
- Set of plant identification field guides—one for each group in class

Procedure

Day one (50 minutes)

1. Prepare in advance by making a set of transect lines—one for each group in class. Tie heavy twine or nylon rope to a tent peg or small wooden stake. Measure out 10 meters of line and fasten the other end to another peg or stake at that point.
2. Set up transect lines by driving one peg or stake into the ground, stretching the line tight and driving the other into the ground. (Alternatively, class time may be used having students make and set their own transect lines.) If possible, choose transect line placements that show changes of plant species as along the line. For example, moving from a tree-covered area to an open field, from a mowed area to an unmowed area or down a slope.
3. Take the class outside. (If that is not possible, the activity may be adapted for indoor use by having students identify and count objects found in the classroom.)
4. Provide each student with a copy of Plant Sampling—Line Transect Survey Investigation.
5. Lead the class through the procedure.
6. Have students place the completed data sheets in their science notebooks.

Day two (25 minutes)

1. Invite students to share drawings, rubbings, samples or descriptions of plants they could not identify. Have the class identify as many as possible.
2. Have each group report their plant sampling findings.
3. Briefly summarize findings from the class's multiple samplings on the board.
4. Ask students what generalization or conclusions they would draw from their plant sampling findings. How diverse is the plant life on the school grounds?

PLANT SAMPLING—LINE TRANSECT INVESTIGATION

Objective

Determine the species composition of plant life on school grounds using line transect sampling.

Directions

1. Work with your partners following your teacher’s instructions to conduct a valid sampling.
2. One student should act as recorder for your group’s observations. Other students should work together to count and identify plants.
3. Use plant identification guides to help you identify and list each species that touches the line. If you cannot identify a species, describe or draw it as well as you can. With your teacher’s permission, you may make a leaf rubbing or take a sample to identify later.
4. Make a tick mark under the “Individuals” column for each individual of a species that touches the line, but only count each individual once (this may be hard to determine for grasses and some other plants!).
5. Count live plants only—you want your data forms to reflect current conditions, not past.
6. Imagine that the line is a plane that extends into the sky. If the vertical plane would touch a plant above the ground, count it. Examine each vertical layer of plants separately: upper (e.g., trees), middle (e.g., shrubs), lower (ground-level, e.g., grasses).
7. Add up the tick marks in each row and enter the result in the right-hand column under “Total” for that row. Then add up the total number of species and enter that result at the bottom of the second column (“Total species”). Finally, add up all the numbers in the “Total” column and enter the result at the bottom of the column (“Total individuals”).

Copy Page

Location: _____

Layer	Species name or description	Individuals	Total
Total species:		Total individuals:	

Activity 6.8: Student Investigation of Plant Sampling

Students apply what they have learned in the preceding activities to create a data table to record plant sampling data and observations in preparation for their field study day.

Estimated Time

25 minutes

Required Materials

- Notebook paper
- Pens or pencils

Procedure

1. Instruct students to work in teams to decide the best way to record plant identification, sampling data and observations as part of their field study day.
2. Have each team create a data table and have each student make a copy for his/her notebook.

Chapter 6 Assessment

Directions

Select the best answer for each of the following multiple-choice questions.

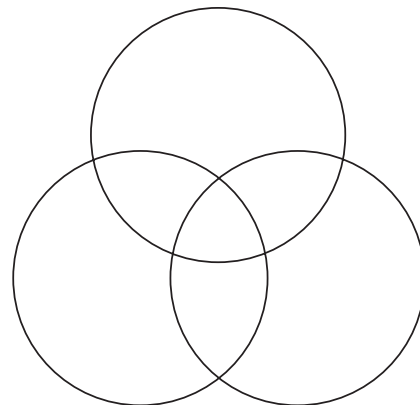
1. Why do scientists use sampling?
 - a. To create new habitat
 - b. Because each part of an ecosystem is connected to and depends on all the others
 - c. Because ecosystems may change in response to natural or human-caused events
 - d. To estimate things without having to count each organism
2. What is an endangered species?
 - a. A type of plant or animal no longer in existence, having died out leaving no living representatives
 - b. A type of plant or animal with a variety and number of different organisms and populations
 - c. A type of plant or animal whose numbers are so small that it is at risk of extinction
 - d. Both a and c
3. What does it mean for a species to be extinct?
 - a. A type of plant or animal no longer in existence, having died out leaving no living representatives
 - b. A type of plant or animal with a variety and number of different organisms and populations
 - c. A type of plant or animal whose numbers are so small that it is at risk of extinction
 - d. Both a and c
4. What is biodiversity?
 - a. A complex web of relationships between living and non-living things
 - b. The variety and number of different organisms and populations, and the way they live together
 - c. The kinds of aquatic ecosystems found in Missouri
 - d. None of the above
5. What kinds of aquatic ecosystems do we have in Missouri?
 - a. Ozarks, Prairie, Lowland and Big River
 - b. Rivers, lakes and wetlands
 - c. Swamps, marshes and fens
 - d. Streams, oceans and ponds

Chapter 6 Assessment

Directions Write your own answer for each of the following questions.

1. What are the biotic and abiotic factors that make up an ecosystem?
2. Describe a beneficial or harmful activity of humans, and explain how these activities affect organisms within an aquatic ecosystem in Missouri. Use one of the following activities as the basis for your example: water pollution, restoration of natural environments, introduction of an invasive species, picking up trash.
3. Predict the impact (beneficial or harmful) on the organisms in an aquatic ecosystem in Missouri of each of the following natural environmental changes: a forest fire in the watershed, a flood, an avalanche that deposits large amounts of rock and soil in the waterbody.
4. Suggest a possible solution to one of the potentially harmful environmental changes within an ecosystem that you used as an example in question 2 or 3.

5. Using the Venn Diagram to the right, compare and contrast Missouri's three types of aquatic ecosystems. Be sure to label each part of the diagram with the name of the ecosystem it represents.



Chapter 6 Assessment Answer Key

Multiple-choice questions

- 1. Why do scientists use sampling?
d. To estimate things without having to count each organism
- 2. What is an endangered species?
c. A type of plant or animal whose numbers are so small that it is at risk of extinction
- 3. What does it mean for a species to be extinct?
a. A type of plant or animal no longer in existence, having died out leaving no living representatives
- 4. What is biodiversity?
b. The variety and number of different organisms and populations, and the way they live together
- 5. What kinds of aquatic ecosystems do we have in Missouri?
b. Rivers, lakes and wetlands

Write-in questions

- 1. What are the biotic and abiotic factors that make up an ecosystem?
The biotic (living) parts of the ecosystem are the communities of plant and animal populations, including humans. The abiotic (non-living) parts include sunlight, air, water, temperatures, soil and minerals.
- 2. Describe a beneficial or harmful activity of humans, and explain how these activities affect organisms within an aquatic ecosystem in Missouri. Use one of the following activities as the basis for your example: water pollution, restoration of natural environments, introduction of an invasive species, picking up trash.
Many answers are possible, but should resemble one of the following examples:

Human activity	Specific example of affect on organisms
Water pollution	Runoff polluted with insecticides could kill all the insect larvae living in a stream. This could cause the food web to collapse and most fish species to die.
Restoration of natural environments	Removing a river levee could allow natural oxbow lakes and wetlands to reform. This would restore habitat for fish species that need shallow, slow-moving water.
Introduction of an invasive species	Dumping a bait bucket full of crayfish that are not native to a stream could introduce a species that competes with the native crayfish. This could cause the native species to become endangered.
Picking up trash	Fish, birds and other wildlife die or get injured from swallowing or being tangled in plastic trash. Removing plastic bags, used fishing line and other plastics could reduce the number that die or get injured.

- 3. Predict the impact (beneficial or harmful) on the organisms in an aquatic ecosystem in Missouri of each of the following natural environmental changes: a forest fire in the watershed, a flood, an avalanche that deposits large amounts of rock and soil in the water body.
Many answers are possible, but should resemble one of the following examples:

Natural environmental change	Specific example of affect on organisms
Forest fire in the watershed	Loss of plants in the watershed could result in increased erosion and sediment entering a water body. These changes may destroy habitat for some species and create it for others. When the plants grow back, the ecosystem will return to normal.
Flood	A flood could wash some fish, plants or other aquatic life away, but would not cause long-term damage. It could even have benefits, such as restoring wetland areas and bringing fresh nutrients. The greater the biodiversity in an ecosystem, the healthier, more sustainable and better balanced it is.
Avalanche that deposits large amounts of rock and soil in the water body	An avalanche could result in increased erosion and sediment entering a waterbody. It could cause a pond or wetland to fill in and become dry, or could cause a river to change course. These changes may destroy habitat for some species and create it for others.

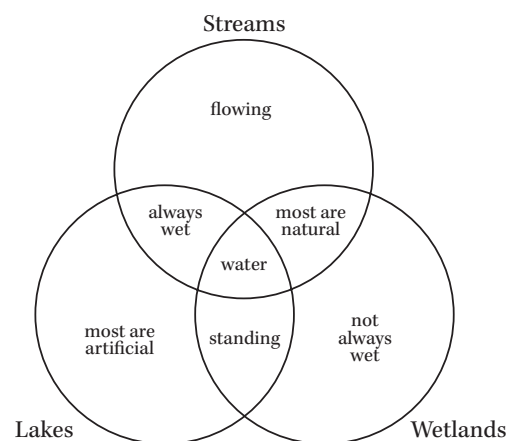
4. Suggest a possible solution to one of the potentially harmful environmental changes within an ecosystem that you used as an example in question 2 or 3.

Many answers are possible, but should resemble one of the following examples:

Potentially harmful environmental change	Specific example of affect on organisms	Possible solution
Water pollution	Runoff polluted with insecticides could kill all the insect larvae living in a stream. This could cause the food web to collapse and most fish species to die.	Prevent water pollution through regulating insecticide use and by educating people about the potential for harm. Protect and restore habitat for the native species and consider hatchery spawning to support wild populations.
Introduction of an invasive species	Dumping a bait bucket full of crayfish that are not native to a stream could introduce a species that competes with the native crayfish. This could cause the native species to become endangered.	Prevent introduction of the invasive crayfish species by educating people about the potential for harm. Protect and restore habitat for native crayfish species and consider hatchery spawning to support wild populations.
Natural environmental changes	Generally do not have long-term harmful effects	Solutions to potentially negative temporary effects should emphasize protecting and restoring a wide variety of habitat, maintaining biodiversity and allowing nature to take its course.

5. Using the Venn Diagram to the right, compare and contrast Missouri's three types of aquatic ecosystems. Be sure to label each part of the diagram with the name of the ecosystem it represents.

Many answers are possible, but all should resemble the following example:



Enrichments

Project WILD Aquatic:

- Aquatic Roots
- Edge of Home
- Watered-Down History

Guest speaker:

- Fisheries biologist. If invited for Activities 6.2, 6.3 or 6.6, the speaker may be able to assist with instruction as well as talk about fisheries management and aquatic ecosystems.

Additional enrichments:

- Students keep a classroom aquarium.